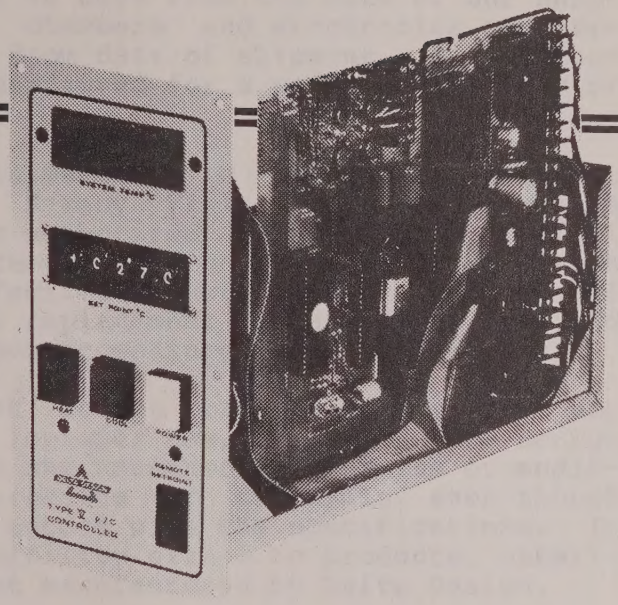
A 1570

INSTRUCTION MANUAL

Model A1570



DELTA DESIGN® INC

MADE IN USA

TYPE V CONTROLLER

(Microcomputer Based)

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ENVIRONMENTAL CONTROL EQUIPMENT FOR RESEARCH AND INDUSTRY

5775 KEARNY VILLA ROAD SAN DIEGO, CALIFORNIA 92123

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Obligation under this warranty is limited to repair at the factory (5775 Kearny Villa Rd., San Diego, CA 92123) or one of our authorized service stations, or at our option, replacement of any product Delta Design determines to be defective or not in accord with stated specifications. All replacement parts will be invoiced and credit issued upon acceptance of defective part.

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NOTE

IT IS RECOMMENDED THAT THIS MANUAL BE READ THOROUGHLY BEFORE CONNECTING ANY EQUIPMENT TO ELECTRICAL POWER.

INTRODUCTION

The Delta Design, Inc., Type V Controller has been specifically designed for use with Delta Environmental Test Chambers, Burn-In Chambers, and Environmental Handlers, but is adaptable for use with any system which can utilize a type J (iron constantan) thermocouple as a sensor.

The Type V Controller is a high precision, microcomputer based controller which utilizes digital techniques to provide control action for the temperature system. The Controller has the capability to change its control parameters automatically, thereby allowing the controlling action to adapt to a particular chamber and its unique thermal response characteristics. Utilizing these principles, the Controller's microcomputer automatically performs the regulation of both heat and/or coolant of the temperature system. This is accomplished by providing separate output time proportioning commands. The Type V Controller also provides built-in cold junction compensation and open thermocouple protection. The digital display located on the control panel indicates actual system temperature with a resolution of 0.1 degrees centigrade. The display also will provide feedback if the thermocouple sensor is open by displaying "P.OP.". If an improper setpoint is entered on the digital thumbwheel switches or the remote setpoint switch is activated without proper interface, the display will indicate "----". When the display indicates either "P.OP." or "----", heater power and/or coolant are disabled.

The Controller features built-in interface capability for remote or external temperature control setpoint selection, as well as external programming.

Standard interface capabilities are: 16 lines I/O plus two handshake lines. The I/O lines may be steady state (BCD), latched input or computer interface. Optional interface capability is with the IEEE 488 Bus. This allows the Type V Controller to be directly tied into a computer controlled instrumentation system.

SPECIFICATIONS

TEMPERATURE RANGE	-73 to +315 degrees centigrade or -73 to +175 degrees centigrade (Selectable with a jumper wire added) (Controller provides automatic shutdown if setpoint goes out of limits - display will indicate ----)
RESOLUTION	0.1 degree centigrade (Digital Display and Setpoint)
CONTROLLER ACCURACY	+/-0.1 degree centigrade
REPEATABILITY	+/-0.1 degree centigrade
SENSOR	Type J thermocouple (iron constantan)
COLD JUNCTION COMPENSATION	Built-in; compensation error <.01 degree C/degree C ambient
SENSOR LINEARIZATION	23 segment, digital, no calibration required
SHORT TERM STABILITY	+/-0.1 degree centigrade
DEADBAND	0.1 degree centigrade
LINE VOLTAGE COMPLIANCE	.001 degree centigrade/volt RMS
CONTROL MODE	PID (Proportional/Integral/Derivative) Control, time proportioning with zero-voltage-switching, automatic heat or cool. PID function is "self-adaptive", ie., the control function automatically adjusts itself for optimum chamber performance.
HEAT OR COOL PROPORTIONAL BAND WIDTH	6.4 degrees centigrade
DISPLAY UPDATE RATE	7.5 readings/second
TIME PROPORTIONING PERIOD	1 second

CALIBRATION PROCEDURE**	Two steps; no iterations 1. Ambient* 2. (Full scale) Slope
CONTROLLER OUTPUTS	Heat (zero crossover controlled solid state switch, 15 amp) Cool (SSR, 129V, 1 amp max.) "Error Nulled" (Contact closure, 200V peak, 0.5 amp non-inductive load)
ADDITIONAL FEATURES	Open thermocouple protection automatic shutdown (display will read "P.OP.") Remote setpoint input (parallel BCD) Remote temperature output (parallel BCD) "Null" contact closure output (temperature within +/-1.6 degrees centigrade of setpoint). Contact rated at 0.5 amp non-conductive.
CONTROLS	POWER ON/OFF Switch/Indicator light COOL ON/OFF Switch/Indicator light HEAT ON/OFF Switch/Indicator light Temperature SETPOINT Control Switch REMOTE SETPOINT Control Switch/Indicator
VOLTAGE REQUIREMENTS (Derived from temperature chamber or handler)	120 VAC, 50/60 Hz, Single Phase
NET WEIGHT (approx.)	4 lbs. (1.81 Kg)

FOOTNOTES

* Unless otherwise specified:
Ambient temperature = 25 degrees centigrade
+/- 10 degrees centigrade
Line Voltage = 115 VAC +/- 10 degrees

** This procedure calibrates the controller display and control simultaneously.

CONTROLLER MODEL NUMBERS

120V	208-240V	208-240V for 7650	Temperature Range	Front Panel
A1570-1	A1570-3	--------	-73° C to +175° C	Vertical
-------	-------	A1570-4	-73° C to +175° C	Horizontal

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1.0 PRINCIPLE OF OPERATION

1.1 Description

1.1.1 The Controller utilizes a type J (iron-constantan) thermocouple as a sensor in the temperature control system. The output of this sensor is amplified by a differential DC solid state feedback amplifier and is applied to the input of a 12 bit dual slope A/D (analog to digital) converter (the A/D converter incorporates automatic zero drift compensation and has a conversion rate of 7-1/2 conversions per second). The converted sensor output signal can then be processed by the microcomputer in the temperature controller.

1.1.2 The microcomputer compares this system feedback signal to the setpoint as selected on the digital thumbwheel switches. The Controller, through the microcomputer, will regulate heat and/or coolant to maintain the set temperature, resulting in minimum coolant and power consumption.

1.1.3 The microcomputer determines error by numerically subtracting the system temperature from the setpoint. It performs other numerical operations as well, including integral feedback, rate feedback, and the generation of time proportioning outputs to control the heat and cool drivers. It also provides a linear correction of the nonlinearities associated with the thermocouple. All these operations done numerically, eliminate linearization adjustments, rate adjustments, and integration adjustments required to match the requirements of a particular system.

1.1.4 The Controller incorporates adaptive feedback control and measures the response of the thermal system it is controlling, when the system is heating or cooling outside of the heat or cool proportional band (6.4 degrees centigrade). The controller uses this measured response to automatically adjust the variables in the temperature control algorithm so as to enhance the setting characteristics of the total system. This adaptive capability alleviates the need for adjustments other than the initial ambient temperature reading calibration and full scale calibration.

2.0 INITIAL SETUP

WARNING

ENSURE THAT ALL SOURCES OF POWER HAVE BEEN REMOVED FROM THE EQUIPMENT PRIOR TO INSTALLING, REMOVING OR SERVICING THE CONTROLLER.

CAUTION

Some components used on the Controller PC board are static charge sensitive. Unnecessary handling should be avoided. Removal of components from this board will VOID the Controller warranty.

2.1 Electrical Connection

2.1.1 Electrical connection is made between the Controller and the Chamber or Handler at TB1 and TB2, on the rear of the Controller. For terminal designations, see drawings #1656973 and #1656974 (Figures 6 and 7).

2.1.2 When the Controller and the Chamber or Handler are purchased as a unit, the Controller will be installed in the unit and calibrated prior to shipment.

3.0 STARTING UP PROCEDURE

3.1 Controls

3.1.1 POWER Switch/Indicator Light - ON position - main power to the unit is ON. The white light is illuminated when power is ON.

3.1.2 COOL Switch/Indicator Light - ON position allows the Controller to apply coolant automatically to reach and maintain selected temperature in the test chamber. The blue light is steadily illuminated while the chamber is cooling. The light blinks when the chamber reaches selected temperature below ambient.

3.1.3 HEAT Switch/Indicator Light - ON position allows the Controller to apply heat automatically to reach and maintain selected temperature in the test chamber. The red light is steadily illuminated while the chamber is heating. The light blinks when the chamber reaches selected temperature above ambient.

3.1.4 Digital SETPOINT Switches - Chamber operating temperature is set by dialing the desired temperature into the five thumbwheel switches. The temperature setting capability ranges from -73 degrees centigrade to +315 degrees centigrade (or optional -73 to +175 degrees centigrade).

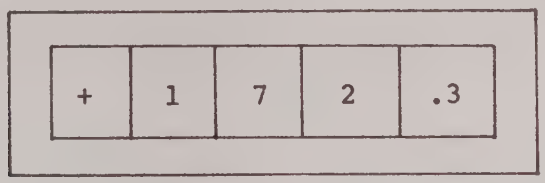
3.1.5 REMOTE SETPOINT Switch and Indicator - The temperature setpoint is normally obtained by setting a thumbwheel switch on the front panel. By actuating the REMOTE SETPOINT switch (LED illuminated), the Controller microcomputer will look at the information present at the "program socket". The program socket is a 25 pin "D" subminiature connector on which lines 1 through 16 are the 4 decades of BCD representing the digital setpoint. If there is no connection at the program socket, the Controller digital display will indicate (----) and heater power and/or coolant will be disabled.

3.2 Setting the Thumbwheel Switches

3.2.1 Description - Refer to example A.

1. Reading from right to left, the first three switch segments are tenths, units, and tens of degrees respectively. These switches each have ten positions and are labeled 0 through 9. The fourth switch segment is hundreds of degrees and is marked 0, 1, and 2.

2. The fifth switch is marked (+) and (-). In the (+) position, all settings dialed in on the other segments will be greater than 000.0 degrees centigrade. In the (-) position, the inverse will be true.



Example A

3.3 Calibration

3.3.1 Install a temperature sensor (thermocouple, resistance temperature detector, or thermistor) with the proper sensor leads in the center of the temperature chamber workspace and close the door. Connect the leads to an appropriate pyrometer or other suitable temperature measuring device.

3.3.2 Switch the controller POWER switch to the ON position. Compare the temperature displayed on the Controller with the temperature on the recorder. On the Controller PC board A1570 (drawing #1657058, Figure 12), adjust the "AMBIENT" potentiometer, R24, until the digital display temperature agrees with the recorder temperature.

3.3.3 Switch the controller HEAT switch to the ON position. Set the digital thumbwheel switches to +100 degrees centigrade. Allow time for the temperature to stabilize. On the Controller PC board A1570 (drawing #1657058, Figure 12), adjust the "SLOPE" potentiometer, R9, until the digital display temperature agrees with the recorder temperature.

3.3.4 The system is now calibrated. Verify the calibration by randomly selecting a test temperature. Allow the chamber to stabilize and verify that the actual temperature as shown on the recorder agrees with what is set on the Controller.

3.4 Changing Temperature Readout

The Controller as supplied, provides readout in degrees centigrade. The settings of the eight-position DIP switch, S1, can be changed to provide readout in degrees Kelvin or degrees Farenheit as follows:

CAUTION

DO NOT use a lead pencil to change DIP switch settings, since conductive graphite may short out the switch.

3.4.1 To change to Farenheit readings, move Section 1 of DIP switch S1 to the YES position.

3.4.2 To change to Kelvin readings, move Section 3 of DIP switch S1 to YES.

3.4.3 To return to Centigrade readings, return switch to original position.

3.5 Running Diagnostics

An automated means of exercising and testing the controller may be accessed through DIP switch S1, Section 2, as follows:

3.5.1 Switch AC power OFF and unplug any accessories connected to the controller, such as a rate programmer or IEEE-488 interface.

3.5.2 Move Section 2 of DIP switch S1 to YES position.

3.5.3 Dial +000.0 (or +0000) on the setpoint switch and switch the controller's AC power ON.

3.5.4 Verify that each digit of the temperature display cycles through its entire character set (0-9, -, E,H,L,P) except for the most significant digit, which will not display the character "0". After cycling the display, the diagnostic program will momentarily turn on decimal point 1 (xxx.x), decimal points 3 & 0 (x.xxx.), and the NULL, HEAT, and COOL outputs in sequence.

NOTE

Dialing a "1" in the least significant setpoint decade, causes the program to expedite to Step 3.5.4. Dialing a "9" causes it to skip Step 3.5.4 altogether.

3.5.5 Upon completion of Step 3.5.4, the program will echo the number dialed on the setpoint switch, back to the display. Decimal point 1 (xxx.x) will be ON. The three digit number to the left of the decimal point will be continuously transmitted to the current loop output. Dialing a number in the range of 0 to 255 inclusive, will vary the current output from minimum (normally 4mA) to maximum (normally

20mA).

NOTE

If any of the special codes (-37XX) called for in the following steps are dialed on the setpoint switches, the program will exit in Step 3.5.5.

3.5.6 Dial -3700 on the setpoint switches. The status of the A/D converted "data valid" output will appear on the temperature display as an alternating "H" and "L", indicating a logic high and low, respectively. As this cycle repeats 7-1/2 times per second, a flicker is barely discernable.

3.5.7 Dial -3701. The A/D converter data output will appear on the temperature display in decimal form. The range of its output extends from -4095 to +4095 decimal. An input voltage greater than that which generates +4095 will cause the message "P.OP" to appear on the display. This indicates that the converter's FAIL output is operating properly.

NOTE

Negative displays will not show the thousands digit, as that space is occupied by the sign. The differential amplifier will typically limit the negative range to something higher than the -4095 point.

3.5.8 Dial -3702. Three "H's" will appear on the display. If the pads for jumper 2732A on the Controller board, are shorted together, the left hand "H" will change to "L", indicating a logic low, or ground on Z1-34. If the SETPOINT VALID line on the accessory interface socket is grounded, the center "H" will change to an "L". If the READ TEMP line on the accessory interface socket is grounded, the right-hand "H" will change to an "L". The latter two checks can be used to verify correct operation of the interface handshake lines.

3.5.9 Dial -3712. This code causes suppression of the program's autocheck "heartbeat" output, simulating entry into a "limbo" state or illegal endless loop. Absence of the autocheck heartbeat for 4 seconds causes the auto-restart circuit, Z2, to issue a power ON reset to the CPU to enable it to recover. The program will then revert to the operation described in Step 3.5.4.

3.5.10 Dialing a -3711 at any time causes operation to revert to that described in Step 3.5.4.

3.5.11 All hardware operation has been verified except for the bidirectional computer interface, differential amplifier, and cold junction calibration. An error in normal operation not detected by the above procedure, requires replacement of the temperature controller program IC in socket Z1.

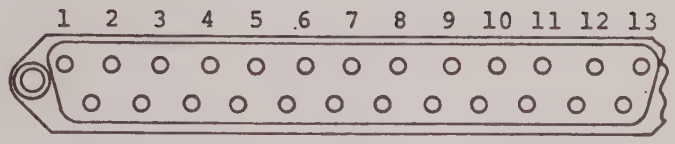
3.5.12 Return Section 2 of DIP switch S1 to NO position before resuming normal operation.

4.0 PROGRAMMING

4.1 Description

The external program socket pinouts are shown in Figure 1. On chamber installations, the Controller microcomputer will utilize the information at this connector when the front panel REMOTE SETPOINT switch is activated (LED illuminated). For other installations, refer to Paragraph B of Pin 12. The connector will accept 16 lines I/O plus two handshake lines. The I/O lines may be steady state (BCD), latched input or computer interface. Optional interface provides IEEE 488 Bus connections.

PIN #	FUNCTION
1	1
14	2
2	4
15	8
	tenths (BCD)
3	1
16	2
4	4
17	8
	units (BCD)
5	1
18	2
6	4
19	8
	tens (BCD)
7	1
20	2
8	4
	hundreds (BCD)
21	Sign (logic) "1" signifies a minus temperature
9	0 Volt (ground reference)
22	
10	
23	
11	$\overline{\text{Null}}$ (logic) temperature difference between setting and actual system temperature greater than 1.6° C causes logic "1".
24	$\overline{\text{Temperature Interrogate}}$ (logic handshake line for external temperature reading).
25	Setpoint Valid (logic handshake for external temperature setpoint input).
13	+5V (50ma max.); typically not connected to internal units.
12	$\overline{\text{Remote}}$ A. For Chambers - When front panel REMOTE switch is depressed, the $\overline{\text{Remote}}$ signal goes low. B. For External Operation - Pin 23 must be grounded.



View looking at male interface connector

FIGURE 1. EXTERNAL PROGRAM SOCKET PINOUTS

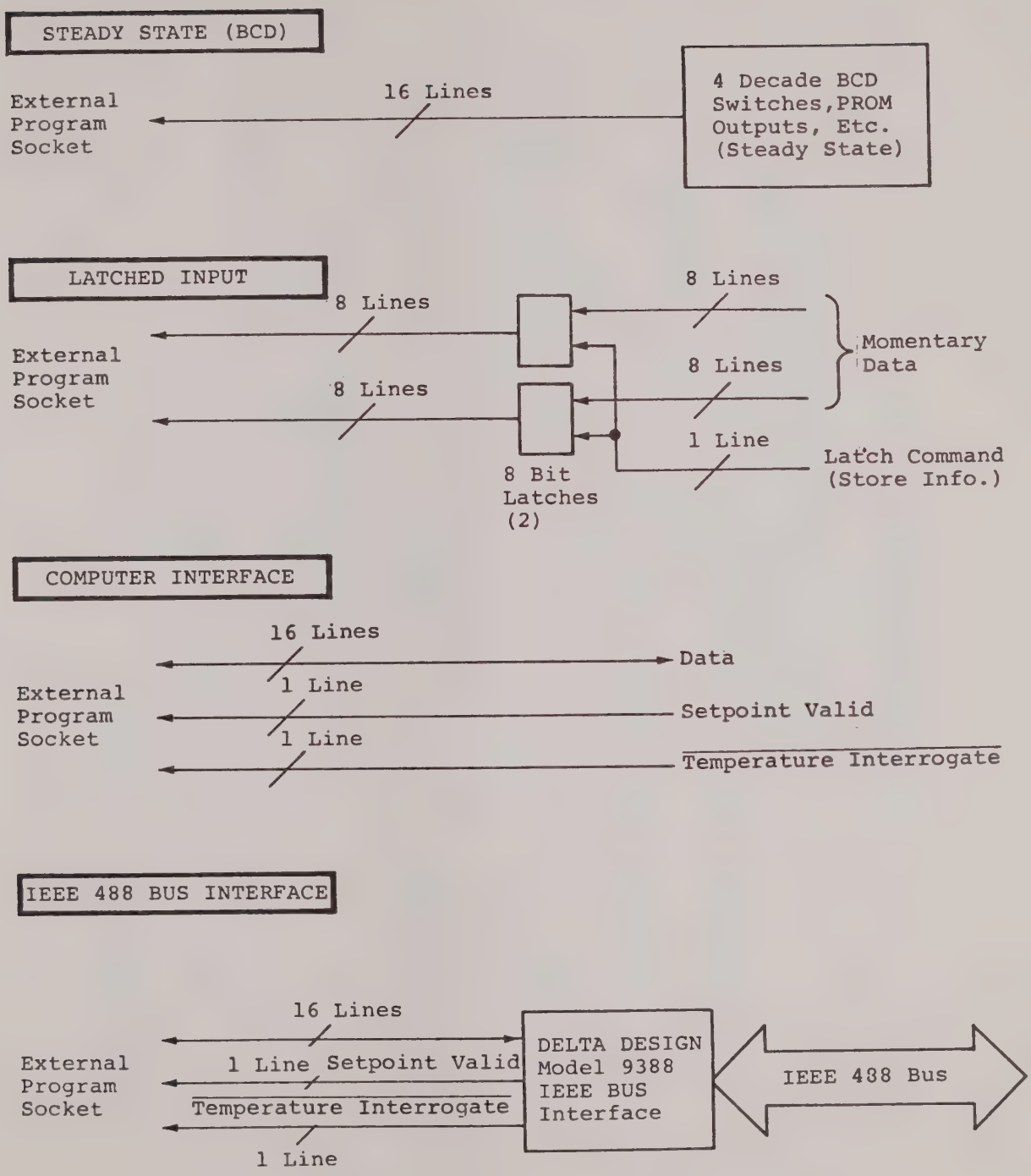


FIGURE 2. INTERFACE CAPABILITES
(All data in parallel format)

INPUT TIMING DIAGRAM
PREVIOUS SETPOINT STABLE
NEW SETPOINT STABLE
REMOTE SETPOINT DATA LINES
"SETPOINT VALID" LINE
120μs MIN.
MAY RETURN HIGH ANYTIME AFTER NEW SETPOINT IS STABLE
NOTE 1. THE CONTROLLER SAMPLES THE REMOTE LINES ONCE EVERY 1.2 SECONDS. IF "SETPOINT VALID" IS FALSE AT THAT TIME, IT WILL HOLD THE PREVIOUS SETPOINT UNTIL THE NEXT SAMPLE.
OUTPUT TIMING DIAGRAM
LATCHED
OPEN COLLECTOR OR HIGH Z
LATCHED
SETPOINT DATA IN
RESTORE SETPOINT DATA IN AFTER SAMPLING TEMPERATURE DATA OUT
"SETPOINT VALID" LINE
120μs MIN.
RAISE "SETPOINT VALID" AGAIN AFTER SETPOINT DATA IN IS STABLE
"TEMPERATURE INTERROGATE" LINE
150 ms MIN.
SEE NOTE 2 BELOW
50μs MIN. (TO ENSURE STABLE TEMPERATURE DATA OUT)
TEMPERATURE DATA OUT MAY BE SAMPLED
NOTE 2. TEMPERATURE DATA OUT IS SAMPLED EVERY 150 ms AS LONG AS "INTERROGATE" AND "VALID" ARE HELD LOW. DATA OUT IS LATCHED WITHIN 50μs AFTER "INTERROGATE" RETURNS TO ITS HIGH LEVEL, AND IT REMAINS LATCHED UNTIL "VALID" GOES HIGH OR UNTIL "INTERROGATE" AGAIN GOES LOW.
NOTE 3. THE PERIOD BETWEEN INTERROGATE CYCLES SHOULD BE >1.2 SECONDS. (SEE NOTE 1)
TIMING DIAGRAM-BIDIRECTIONAL PARALLEL BCD BUS
SK1046

FIGURE 3. TIMING DIAGRAM - BIDIRECTIONAL PARALLEL BCD BUS

5.0 DRAWINGS AND PARTS LISTS

The following section contains drawings, schematics and parts lists for the Temperature Controller Assembly. Refer to these drawings whenever necessary for troubleshooting and repair, or when ordering parts. Please contact the Delta Design, Inc. Customer Service Department if more information is required.

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPD

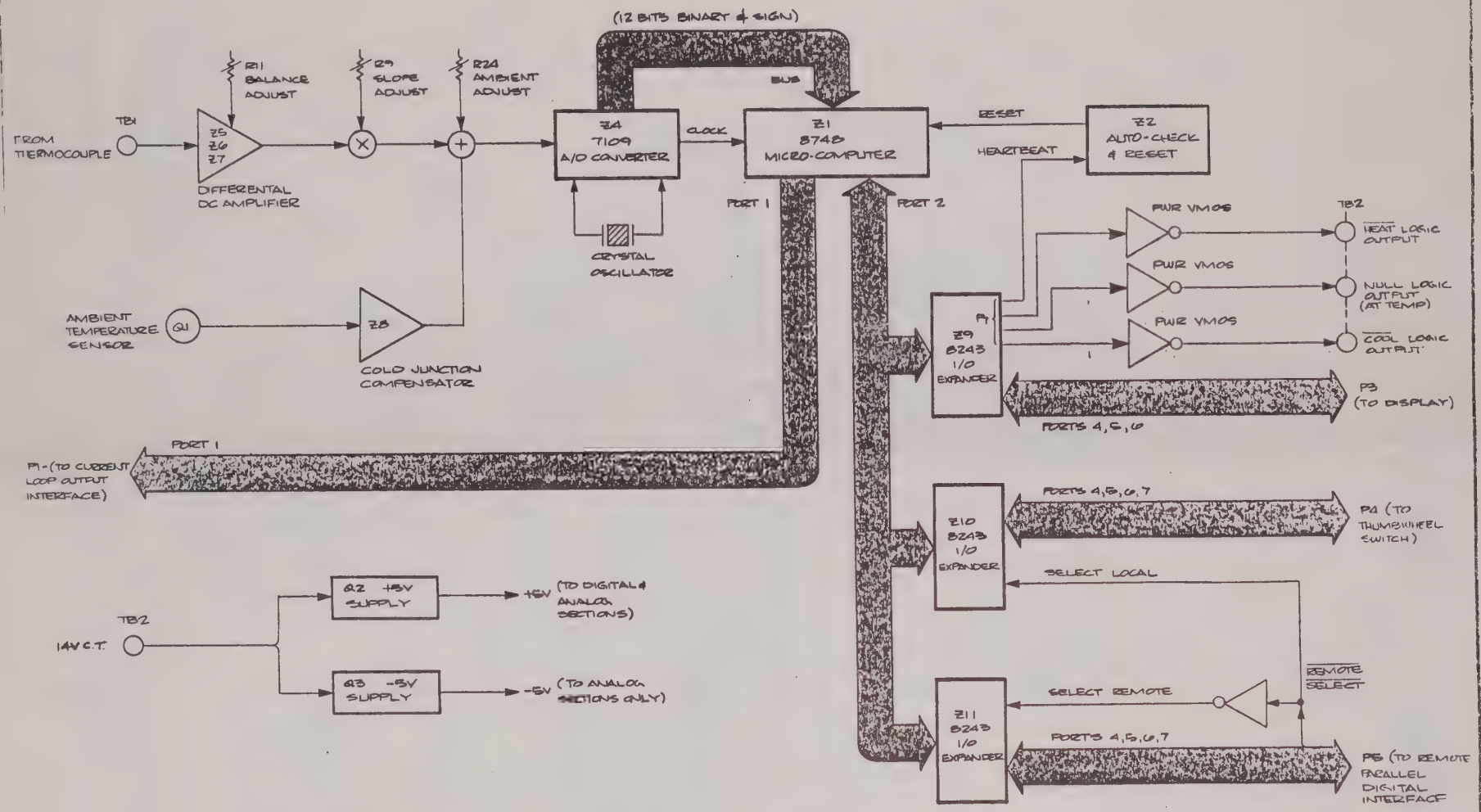


FIGURE 4. BLOCK DIAGRAM, TEMPERATURE CONTROLLER A1570

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DECIMALS ANGLES

ENGINEERING ACTIVITY

DELTA DESIGN INC. A SUBSIDIARY OF CONTROL INC. SAN DIEGO, CA. 92123

DASH	QTY	NEXT ASSY	USED ON
		APPLICATION	

SERIAL NO. | DATE EFF | DWG REV | EFFECTIVITY

MATERIAL | FINISH

APPROV | RELEASE | DO NOT SCALE DWG

SIZE C | CODE IDENT | 1045 | B

SCALE N.A. | 1644555 | SHEET 1 OF 1

⚠ FINISH (IF APPLICABLE)

⚠ MATL (IF APPLICABLE)

NOTES: UNLESS OTHERWISE SPECIFIED

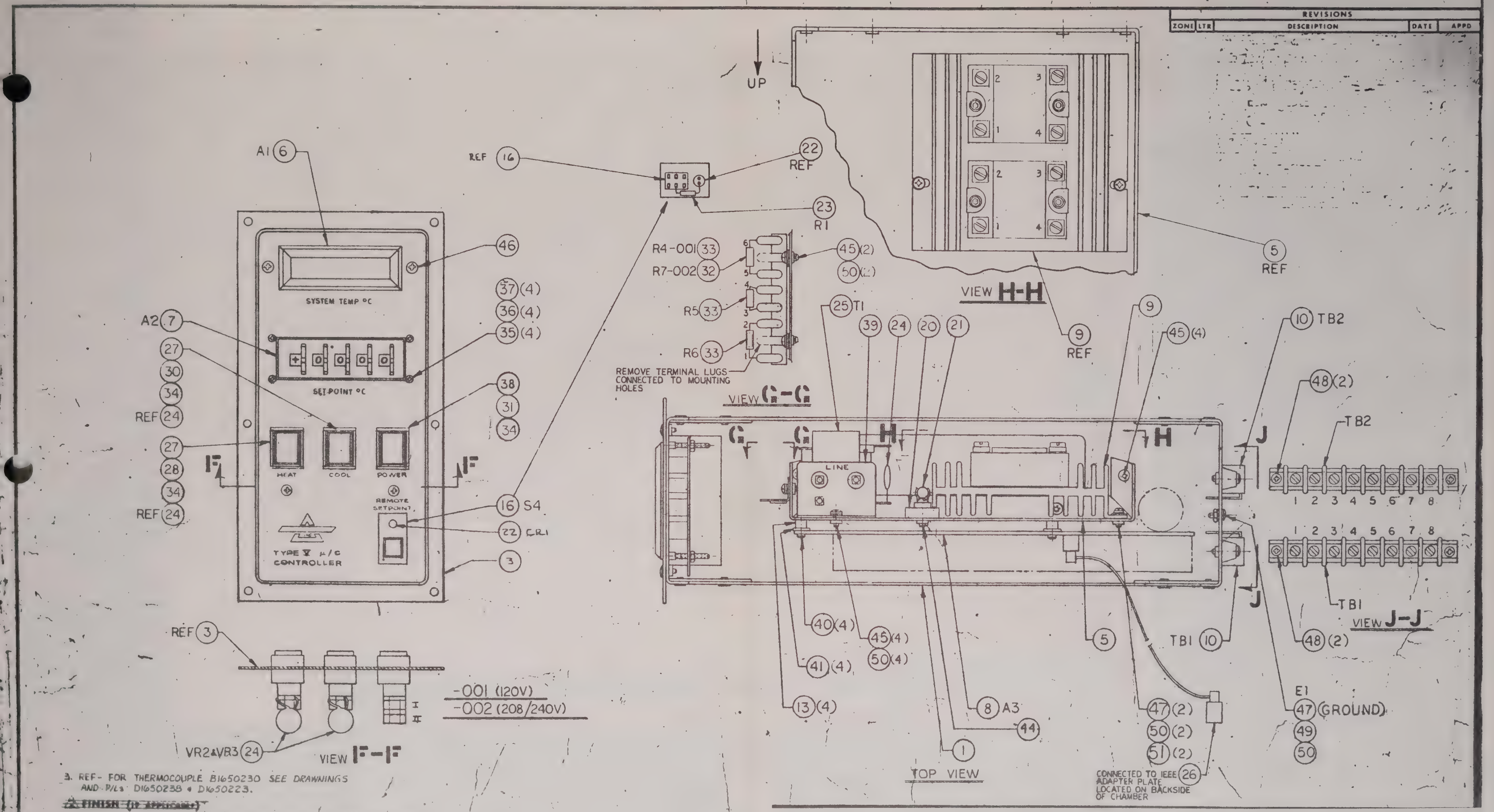


FIGURE 5. TYPE V CONTROLLER ASSEMBLY, 120/208-240V (1656972, 1 of 2)

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPD

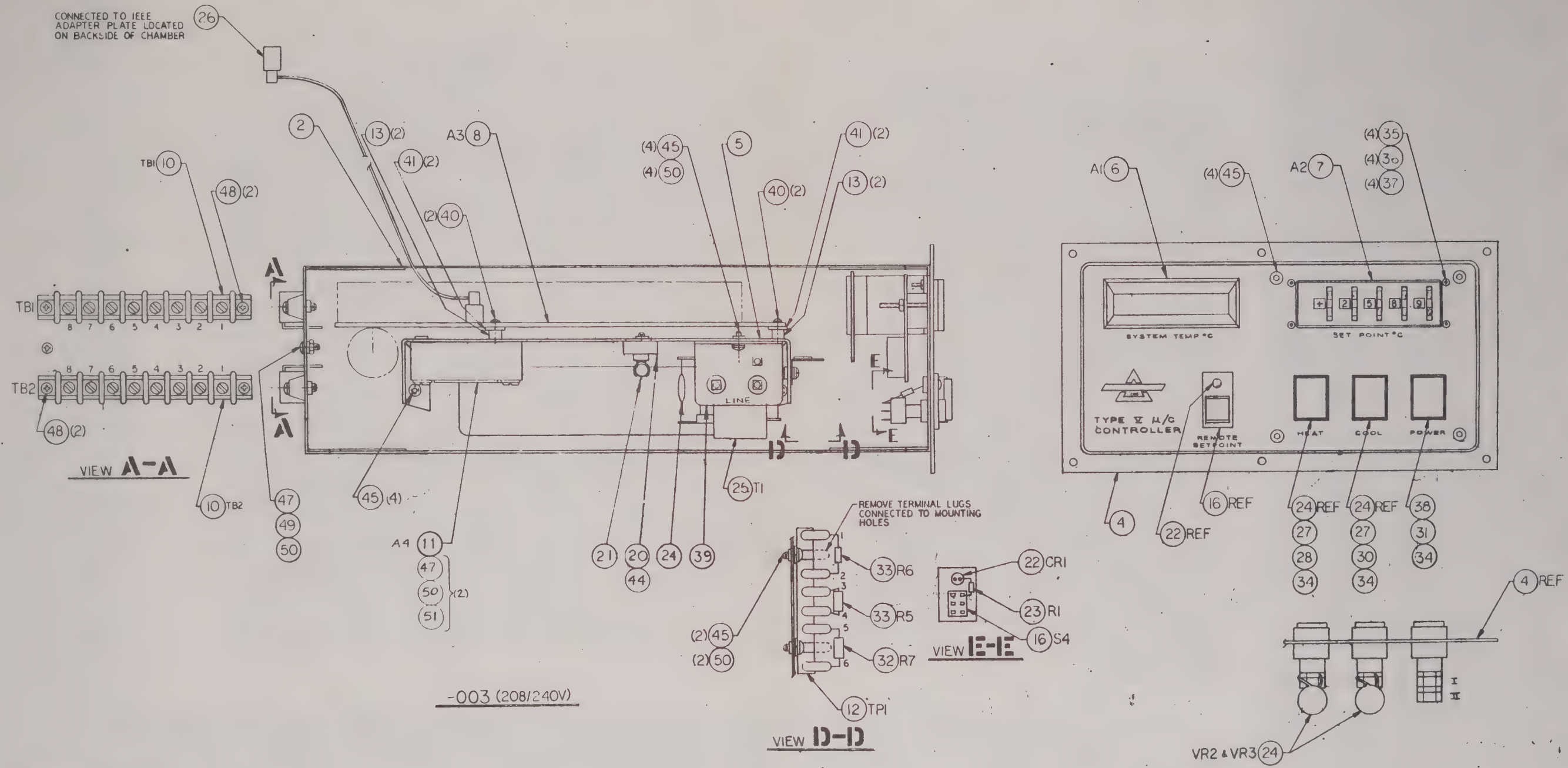


FIGURE 5. TYPE V CONTROLLER ASSEMBLY, 208-240V (1656972, 2 of 2)

⚠ FINISH (IF APPLICABLE)

⚠ MATL (IF APPLICABLE)

NOTES: UNLESS OTHERWISE SPECIFIED

Type V-0885

P.L. 1656972 REV ____ SHT 1 OF 3

DESCRIPTION TYPE V CONTROLLER

NEXT ASSY END ITEM BY RANGE CK'D ____ APPD C.L. 9/1/84

REV ECN DATE BY APP

DELTA DESIGN
5725 KEARNY VILLA RD.
SAN DIEGO, CALIF.

JOB NO. ____ S.O. NO. ____

QTY ____ PROM DATE ____ ACT ____

RUN # ____ MACH ____

ITEM NO	ASSY & QTY -001	-002	-003	-004	INDENTURE	SIZE	DRAWING NO.	REV	DESCRIPTION	MFG OR MFG NO.	STOCK OR PART NO.	JOB QTY	ALL	QTY REC	FAB CD	PURCHASING P.O. NO.	QTY. DUE	REC'D	MANUFACTURE ACT EST ACT HRS.	COM'D	COM	PLATE/PAINT IN	OUT	AREA
00	X					D	1656972		TYPE V CONTROLLER	MODEL A1570-1	1656972-001													
00									VERTICAL, 120V	CHAMBER														
00		X				D	1656972		TYPE V CONTROLLER,	MODEL # A1570-3	1656972-002													
00									VERTICAL, 208/240 V	CHAMBER														
00			X			D	1656972		TYPE V CONTROLLER,	MODEL # A1570-4	1656972-003													
00									HORIZONTAL, 208/240 V	CHAMBER														
00																								
00																								
00	REF	REF				D	1656973		WIRING DIAGRAM,	120/208/240 V														
00			REF			D	1656974		WIRING DIAGRAM, HORIZ	208/240 V														
00																								
00																								
00																								
00																								
01	1	1				D	1650161		CHASSIS ASSY, VERTICAL		1650161-001													
01	1	1				D	1650161		CHASSIS, VERTICAL		1650161-101													
02	4	4				D	1650161		BRACKET	.036 (20 GA C.R.S.)	1650161-102													
03	9	9							#6-32 WELDNUT		1500175													
02			1			D	1650204		CHASSIS ASSY, HORIZONTAL		1650204-001													
01			1			D	1650204		CHASSIS, HORIZONTAL		1650204-101													
02			4			D	1650204		BRACKET	.036 (20 GA C.R.S)	1650204-102													
03			9						#6-32 WELDNUT		1500175													
03	1	1				C	1650162		FRONT PANEL, VERTICAL		1650162-101													
	REF	REF				B	1650159		ARTWORK, FRONT PANEL, VERTICAL															
04			1			C	1650203		FRONT PANEL, HORIZONTAL		1650203-101													
			REF			C	1650196		ARTWORK, FRONT PANEL, HORIZONTAL															
05	1	1	1			D	1653316		CENTER BRACKET		1653316-101													
06	1	1	1			B	1650192		PCB NUMERIC DISPLAY A1	JCE # A1003	0900002													
	REF	REF	REF			C	1650193		SCHEMATIC	JCE # 1002														
07	1	1	1			B	1644549		PCB TEMP DIGI-SWT A2	JCE # A998	0900003													
	REF	REF	REF			B	1644548		SCHEMATIC	JCE # 997														

NOTES: 1 REF - FOR THERMOCOUPLE B1650230 SEE DRAWINGS AND P/Ls D1650238 & D1650223.

1656972 P/L REV

P.L. 1656972 REV ____ SHT 2 OF 3

DESCRIPTION TYPE V CONTROLLER

NEXT ASSY END ITEM BY RANGE CK'D ____ APPD C Lee

REV ECN DATE BY APR.

DELTA DESIGN
5725 KEARNY VILLA RD.
SAN DIEGO, CALIF.

JOB NO. ____ S.O. NO. ____
QTY ____ PROM DATE ____ ACT ____
RUN ____ MACH ____

ITEM NO	ASSY & QTY -001	-002	-003	-004	INDENTURE	SIZE	DRAWING NO.	REV	DESCRIPTION	MFG OR MFG NO.	STOCK OR PART NO.	JOB QTY	AUL	QTY REC	FAB CO	PURCHASING P.O. NO.	QTY DUE	REC STD	MANUFACTURE ACT EST ACT HRS COM COM	PLATE/PAINT IN	OUT	AREA
08	1	1	1						PC BOARD ASSY A3	JCE # 1570	0900149											
	REF	REF	REF						SCHEMATIC	JCE # 1169												
09	1	1	—			B	1654248		RELAY ASSY, SOLID STATE	(MULTI-USAGE)	1654248-002											
10	2	2	2						TERMINAL BD TB1 & TB2		1400520											
11			1						SOLID STATE RELAY		1400194											
12	1	1	1						TERMINAL STRIP TP1		1400506											
13	4	4	4						STANDOFF	FORGE #350-1300-10-07-00	4100092											
14																						
15																						
16	1	1	1						SWITCH S4	CEK #8261J82	1400180											
17																						
18																						
19																						
20	1	1	1						FUSE HOLDER XF1	LITTLEFUSE #356001	1400053											
21	1	1	1						FUSE 1AMP F1	LITTLEFUSE #314001	1400030											
22	1	1	1						LED CR1	MV5752	1400347											
23	1	1	1						RESISTOR 680Ω 1/2 W	R1	0368000-500											
24	3	3	3						VARISTOR VR2, VR3 & VR8	GE # V180ZA10	1400010											
25	1	1	1						TRANSFORMER T1	JC SYSTEM #241-6-1456	0900005											
26	1	1	1						CABLE ASSY	C801835 JC SYSTEM	0900004											
27	2	2	2						SWITCH MAINTAINED	EAO # 31-261	1400167											
28	1	1	1						LENS CAP RED	EAO # 31-901.2	1400168											
29																						
30	1	1	1						LENS CAP BLUE	EAO # 31-901.6	1400169											
31	1	1	1						LENS CAP WHITE	EAO # 31-901.9	1400170											
32		1	1						RESISTOR 8.2K 3WATT R7	DALE	0600005											
33	3	2	2						RESISTOR 2.7K 3WATT R4,	R5, R6 DALE	0302723-500											
34	3	3	3						LAMP 60V .02 AMP	EAO # 31-963.4	1400085											
35	4	4	4						#2-56 x 3/8 PHP-MS		6802563-804											
36	4	4	4						#2-56 HEX NUT		6702560-001											
37	4	4	4						#2 SPLIT LOCK WASHER		6602010											
38	1	1	1						SWITCH MAINTAINED	EAO # 31-262	1400171											

NOTES:

1656972
P/L

REV

Type V-0885

P.L. 1656972 REV ... SHT 3 OF 3
DESCRIPTION TYPE V CONTROLLER
NEXT ASSY ... BY ... CK'D ... APPD C. Lee

REV ECN DATE BY APP

DELTA DESIGN
5725 KEARNY VILLA RD.
SAN DIEGO, CALIF.

JOB NO. ... S.O. NO. ...
QTY ... PROM DATE ... ACT ...
RUN * ... MACH ...

ITEM NO	ASSY & QTY -001	-002	-003	-004	INDENTURE	SIZE	DRAWING NO.	REV	DESCRIPTION	MFG OR MFG NO.	STOCK OR PART NO.	JOB QTY	ALL	QTY REC	FAB CD	PURCHASING P.O. NO.	QTY DUE	REC'D	MANUFACTURE ACT STD HRS	EST ACT COM	COM	PLATE/PAINT IN	OUT	AREA
39	1	1	1						FILTER	FILTER CONCEPTS SFS	1400096													
40	4	4	4						*4-40 x 1/4 PHP-MS		6804401-404													
41	4	4	4						*4 FIBER WASHER		6604008													
42																								
43																								
44	1	1	1						*6-32 x 3/8 FHP-MS		6806323-801													
45	10	10	14						*6-32 x 1/4 PHP-MS		6806321-404													
46	4	4	4						*6-32 x 1/4 BHS-MS		6806321-499													
47	2	2	2						*6-32 x 3/8 PHP-MS		6806323-804													
48	4	4	4						*6-32 x 1/2 PHP-MS		6806321-204													
49	1	1	1						*6-32 HEX NUT		6706320-001													
50	9	9	9						*6 SPLIT LOCK WASHER		6606010													
51	2	2	2						*6 FLAT WASHER		6606000													
52																								
53			A/R						THERMAL COMPOUND		9900026													
54																								
55																								
56																								
57																								
58																								
59																								
60																								
61																								
62																								
63																								
64																								
65																								
66																								
67																								
68																								
69																								
70																								
71																								

NOTES: NO RESISTORS REQD ON EAD POWER SWITCH M 1400171

P/L 1656972 REV

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPD
	A	PER ECN 45537 REMOVED WIRE FROM TB2-8 TO A3TB2-13		
	B	ECN 61180 A3TB2-13 DISCONNECTED FROM TB1-TB2		

FRONT PANEL

A1 DISPLAY 1650192

A2 DIGI-SWITCH SET POINT 1650194

POWER DS3 COOL DS2 HEAT DS1

POWER S3 COOL S2 HEAT S1

R1 680Ω 1/2 W

CR1 LED FLAT FLV110

S4

T1

FILTER FI

FI 1 AMP

Z2 COOL

Z1 HEAT

RIBBON CABLE

TO CHAMBER THERMOCOUPLE

IRON CONSTANTAN

A3 PC BOARD 1644528

P1 P2 P3 P4 P5

A3TB2

TB1

TB2

TP1

R6 2.7K

R5 2.7K

R4 2.7K-120V

R7 8.2K 208/240V

△ I & II INDICATE SWITCH LEVELS, I IS NEAREST PUSH BUTTON

3-ALL WIRES 20AWG TEFLON UNLESS NOTED

△ FINISH (IF APPLICABLE)

CONNECTIONS FOR 208 & 240V ARE SAME

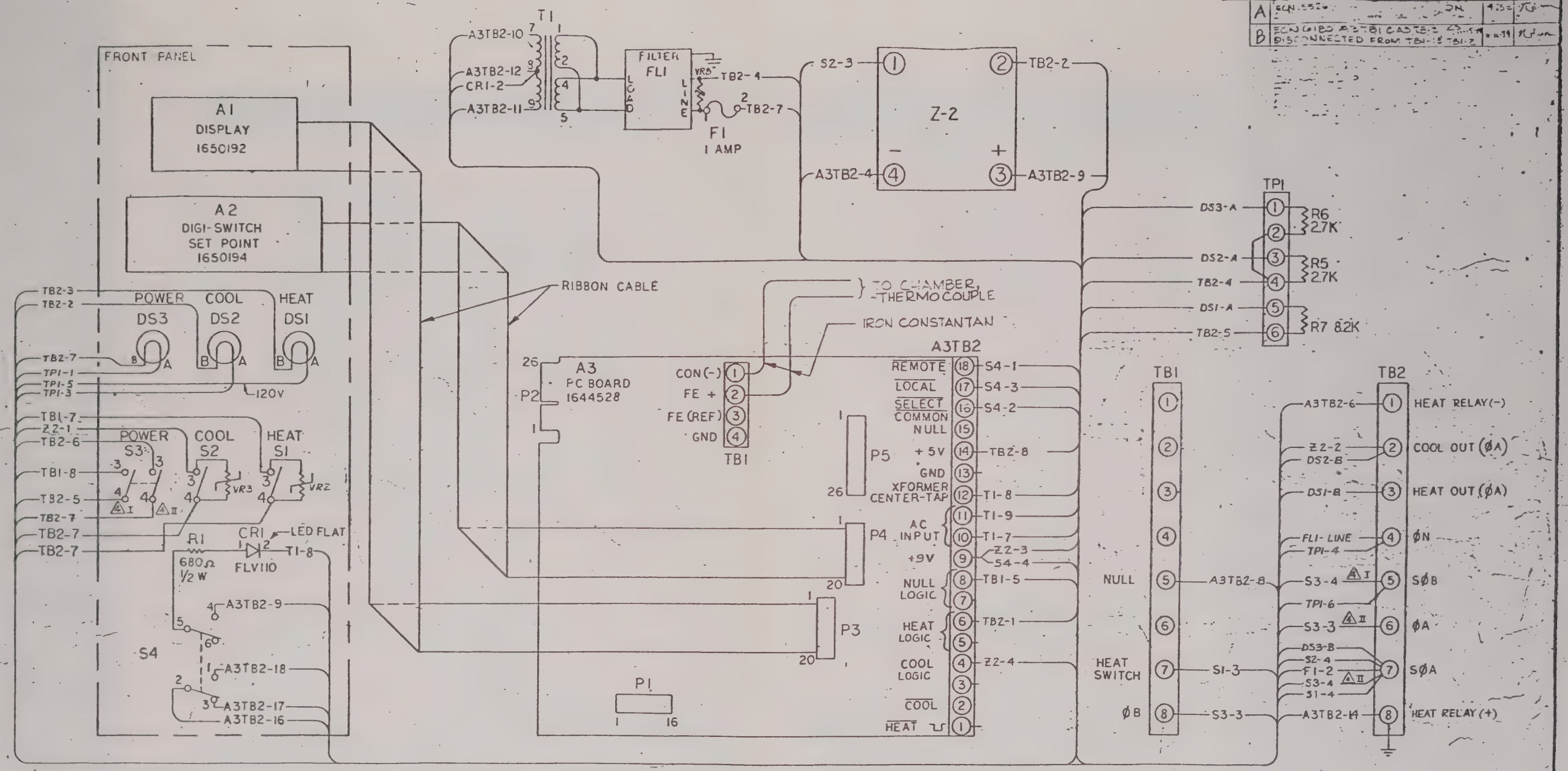
△ MATE (IF APPLICABLE)

WRAP WIRE AROUND SCREW

NOTES: UNLESS OTHERWISE SPECIFIED

FIGURE 6. WIRING DIAGRAM, TYPE V CONTROLLER, 120/208-240V (1656973)

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPD
	A	ECN 6526	4-82	
	B	ECN 6180 A3TB1 CAS TB-2 & -4 DISCONNECTED FROM TB1-8 TB1-2	6-4-84	



⚠ I & II INDICATE SWITCH LEVELS, I IS NEAREST PUSH BUTTON

3-ALL WIRES 20AWG TEFLON UNLESS NOTED

⚠ ~~FINISH (IF APPLICABLE)~~

CONNECTIONS FOR 208 & 240V ARE SAME

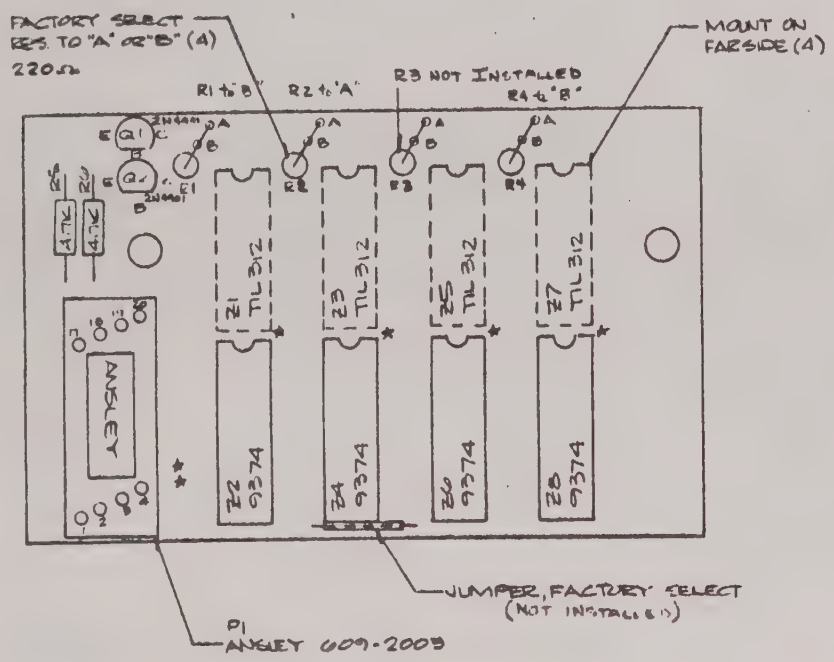
⚠ ~~MATL (IF APPLICABLE)~~

WRAP WIRE AROUND SCREW

NOTES: UNLESS OTHERWISE SPECIFIED

FIGURE 7. WIRING DIAGRAM, TYPE V CONTROLLER, 208-240V (1656974)

ZONE	LTR	DESCRIPTION	DATE	APPD



3. SCHEMATIC: JCE 1002

FIGURE 8. PCB ASSY, NUMERIC DISPLAY II, MODEL A1003

		1605L													
	1	END ITEM		1 ON		NC			APPROV		SIZE	CODE IDENT			
DASH NO	QTY	NEXT ASSY	USED ON	SERIAL NO.	DATE EFF	DWG REV	MATERIAL ⚠		RELEASE		B		1003		
APPLICATION				EFFECTIVITY			FINISH ⚠		DO NO SCALE DWG		SCALE		1650192		SHEET 1 OF 1

⚠ FINISH (IF APPLICABLE)

⚠ MATL (IF APPLICABLE)

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPD

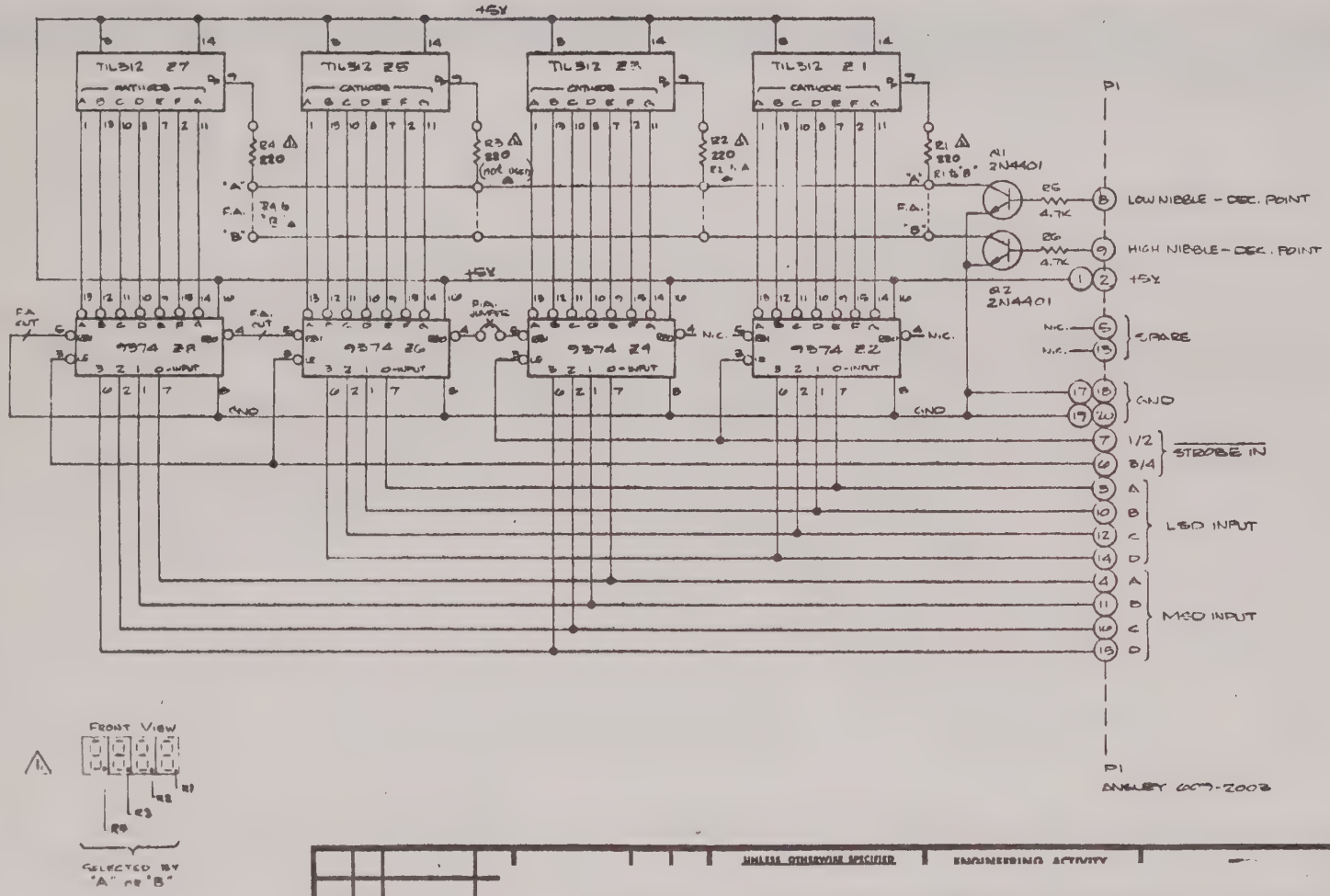


FIGURE 9. PCB SCHEM, NUMERIC DISPLAY II, MODEL A1003

DASH	QTY	NEXT ASSY	USED ON	SERIAL NO.	DATE EFF	DWG REV
	1	A1003				N/C

16501602

UNLESS OTHERWISE SPECIFIED | ENGINEERING ACTIVITY

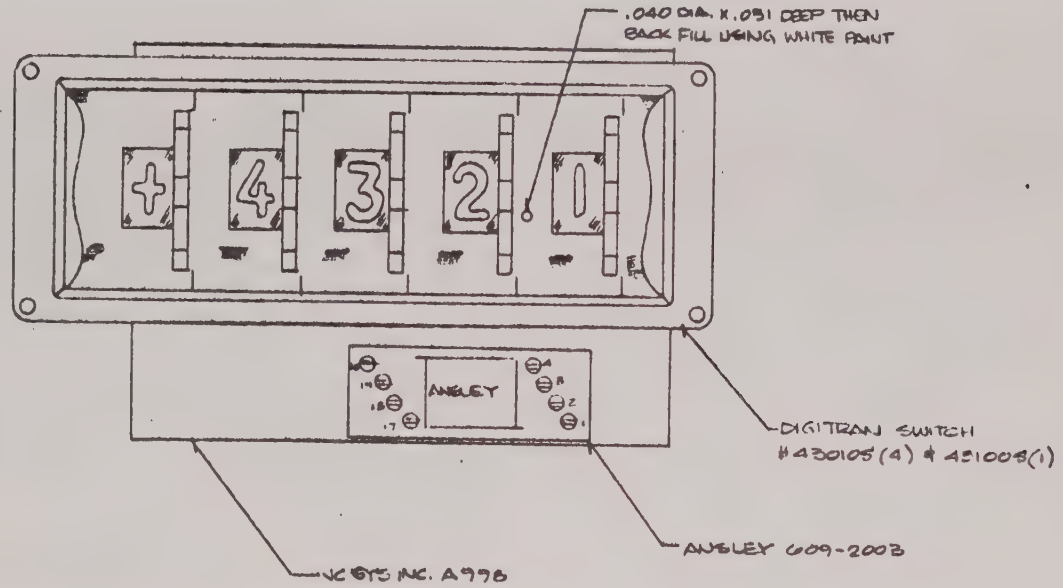
MATERIAL | APPROV | SIZE C | CODE IDENT | 1002

FINISH | RELEASE | SCALE N/A | SHEET ___ OF ___

APPLICATION | EFFECTIVITY | DO NOT SCALE DWG

DTES: UNLESS OTHERWISE SPECIFIED

ZONE	LTR	DESCRIPTION	DATE	APPD



3 SCHEMATIC: JCE 997

⚠ FINISH (IF APPLICABLE)

⚠ MATL (IF APPLICABLE)

NOTES: UNLESS OTHERWISE SPECIFIED

FIGURE 10. PCB ASSY, TEMPERATURE DIGISWITCH II, MODEL A998

DASH	QTY	NEXT ASSY	USED ON
	1	BVD ITEM	
APPLICATION			

SERIAL NO.	DATE EFF	DWG REV
EFFECTIVITY		

MATERIAL ⚠

FINISH ⚠

APPROV	
RELEASE	
DO NO SCALE DWG	

SIZE	CODE IDENT	
B		998
SCALE 2:1		SHEET 1 OF 1

ZONE	LTR	DESCRIPTION	DATE	APPD

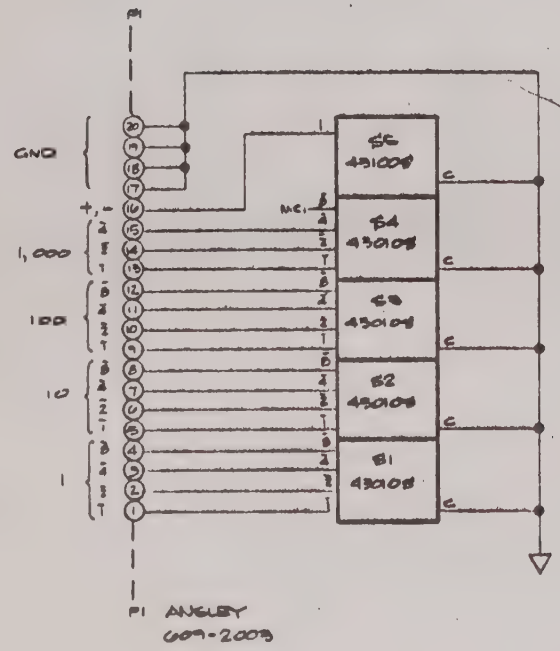


FIGURE 11. PCB SCHEM, TEMPERATURE DIGISWITCH II, MODEL A998

DASH	QTY	NEXT ASSY	USED ON
	1	A998	

SERIAL NO.	DATE EFF	DWG REV
1&UP		NC

APPROV	
RELEASE	

SIZE	CODE IDENT	
B		997

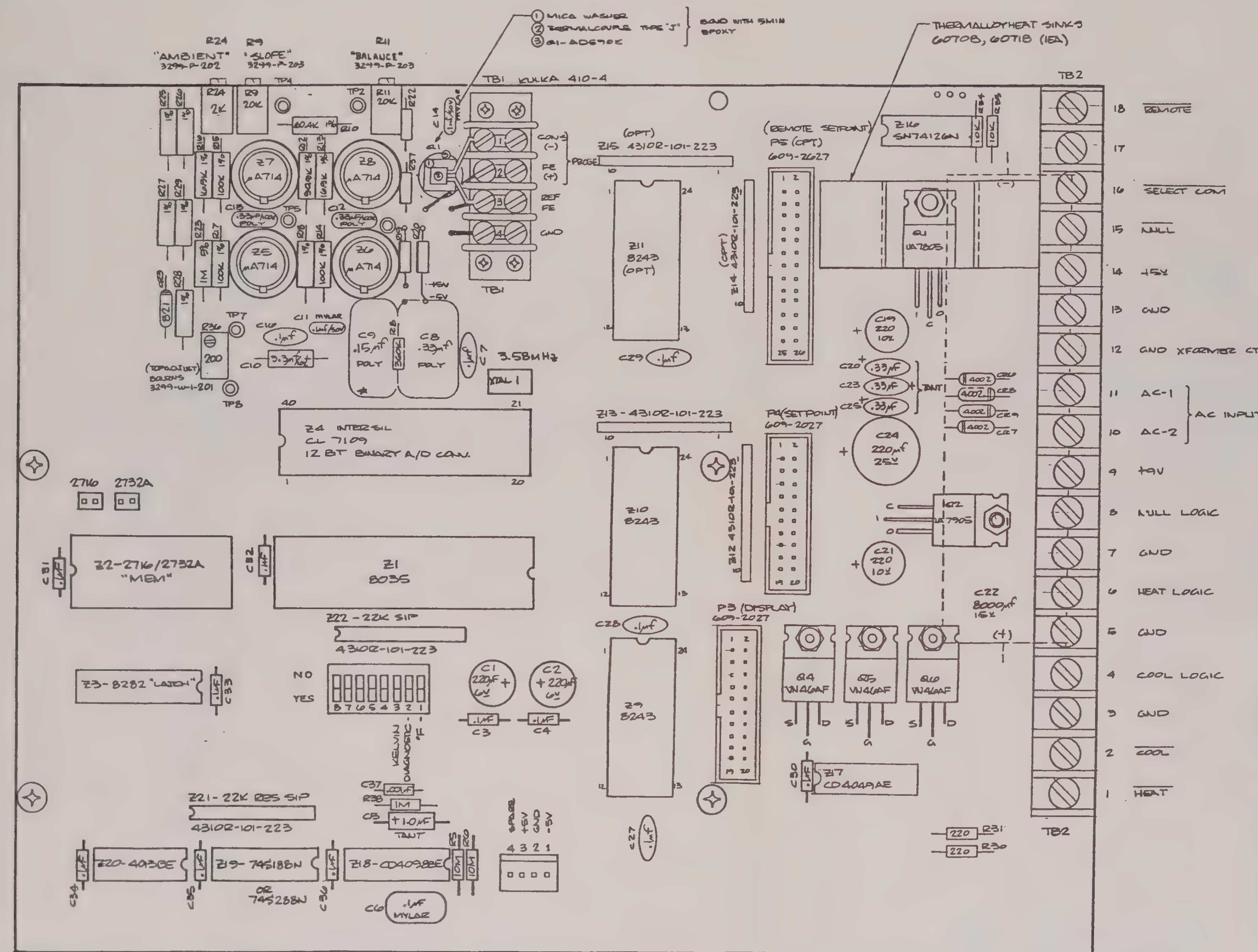
APPLICATION | EFFECTIVITY | MATERIAL ⚠ | FINISH ⚠ | DO NO SCALE DWG | SCALE 1:1 | SHEET 1 OF 1

⚠ FINISH (IF APPLICABLE)

⚠ MATL (IF APPLICABLE)

NOTES: UNLESS OTHERWISE SPECIFIED

ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPD



1 MICA WASHER
2 THERMALCOUPLE TYPE 'J'
3 91-AD590K
BOND WITH 5MIN EPOXY
THERMALLOY HEAT SINKS 6070B, 6071B (1EA)
"AMBIENT" 3299-P-202
"SLOPE" 3299-P-203
"BALANCE" 3299-P-203
TB1 KULKA 410-4
TB2
18 REMOTE
17
16 SELECT COM
15 NULL
14 +5V
13 GND
12 GND XFORMER CT.
11 AC-1
10 AC-2
AC INPUT
9 +9V
8 NULL LOGIC
7 GND
6 HEAT LOGIC
5 GND
4 COOL LOGIC
3 GND
2 COOL
1 HEAT
Z4 INTERSIL CL 7109 12 BT BINARY A/D CON.
Z1 8035
Z2-2716/2732A "MEM"
Z3-8282 "LATCH"
Z10 8243
Z9 8243
Z11 8243 (OPT)
Z16 SN74126N
Z17 CD4049AE
Z18-CD4098BE
Z19-74S188N OR 74S288N
Z20-4013BE
Z21-22K RES SIP 43102-101-223
Z22-22K SIP 43102-101-223
Z13-43102-101-223
Z15 43102-101-223 (OPT)
3.58MHz XTAL 1
P3 (DISPLAY) 609-2027
P4 (SETPOINT) 609-2027
P5 (OPT) (REMOTE SETPOINT) 609-2627
NO
YES
KELVIN
DIAGNOSTIC
2716
2732A
C24 220µf 25V
C22 8000µf 15V
Q4 VN46AF
Q5 VN46AF
Q6 VN46AF

△ PROGRAM 5

△ FINISH (IF APPLICABLE)

△ MATL (IF APPLICABLE)

DELTA STK # 0900149

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED | ENGINEERING ACTIVITY | ▲ DELTA DESIGN, INC

FIGURE 12. PCB ASSY, TYPE V CONTROLLER, MODEL A1570
(1657058)

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPD

FIGURE 13. PCB SCHEM, TYPE V CONTROLLER, MODEL A1570 (1657059, 1 of 2)

NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPD
		— SEE SHT 1 —		

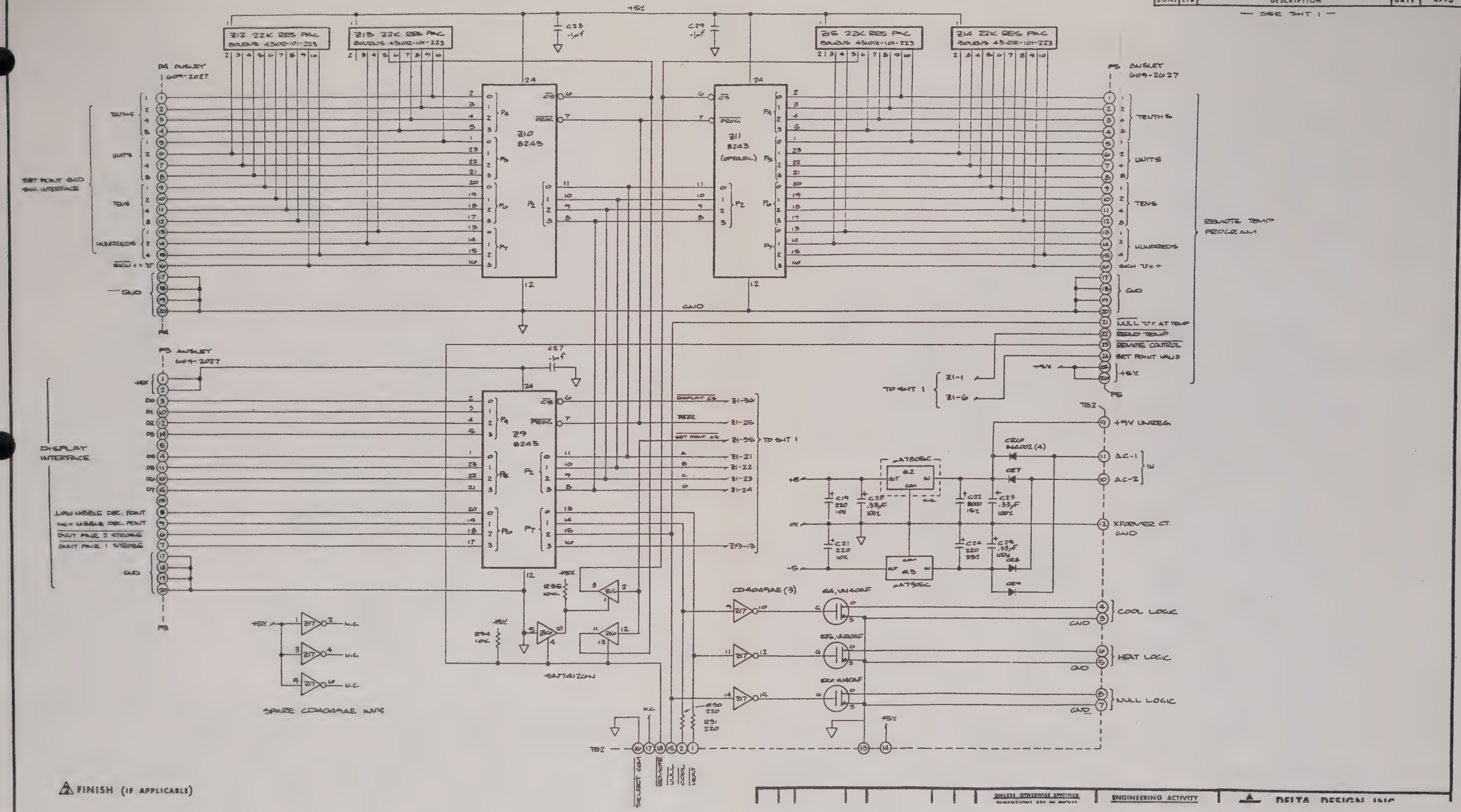


FIGURE 13. PCB SCHEM, TYPE V CONTROLLER, MODEL A1570 (1657059, 2 of 2)

⚠ FINISH (IF APPLICABLE)

⚠ MATL (IF APPLICABLE)

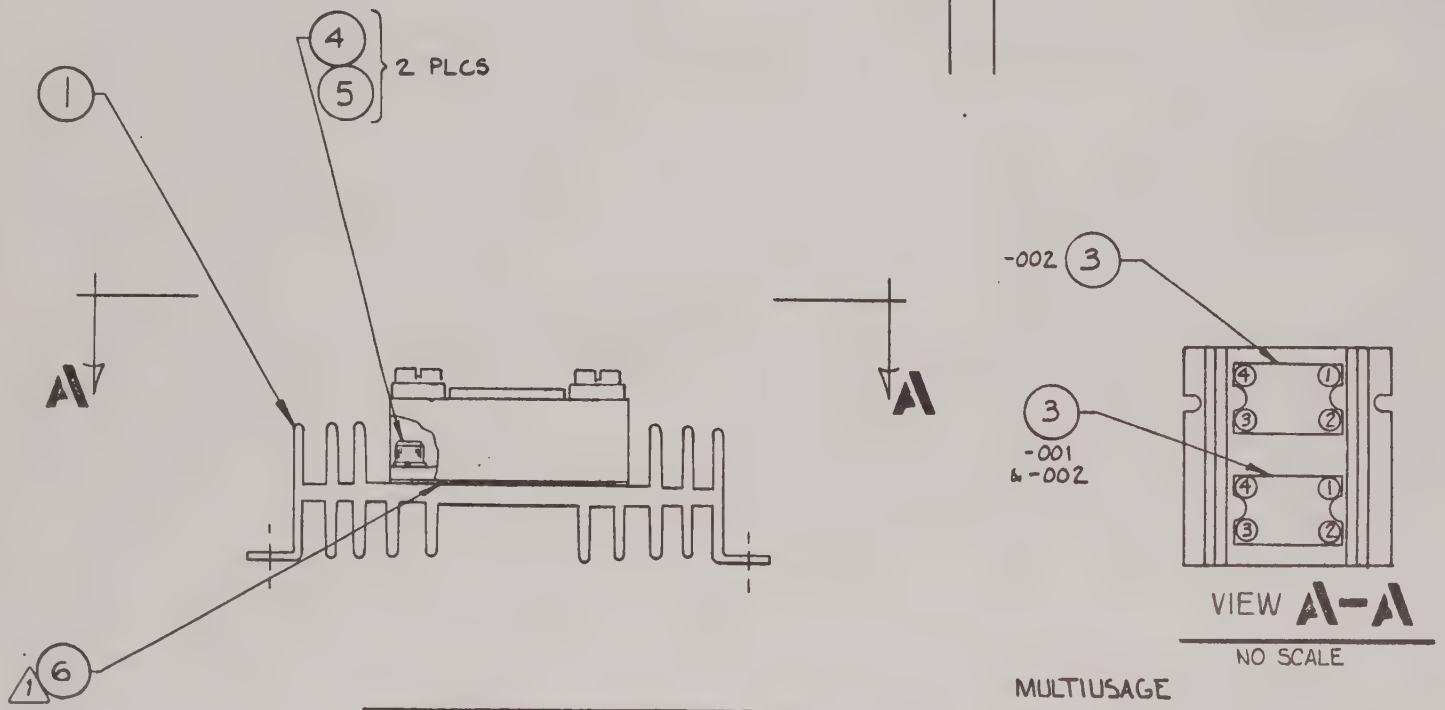
NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED — ENGINEERING ACTIVITY — ▲ DELTA DESIGN INC

EABI FILE CORP IRVINE, CA HANGER EP1142

1654248

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPD
	A	PER ECN 3651 ADDED VIEW A-A	2-13-3	
	B	PER ECN 5180 ADD -002 DN	2-28-84	



MULTIUSAGE

		1656972													
		MULTIUSAGE													
001	1	1648289													
001	1	1691192													
001	1	1690477													
001	1	1650160													
DASH	QTY	NEXT ASSY	USED ON	SERIAL NO.	DATE EFF	DWG REV	MATERIAL	APPROV	C. Lee 3/1/84	SIZE	CODE IDENT	1654248	REV.
APPLICATION				EFFECTIVITY			FINISH	RELEASE		B			B
								DO NOT SCALE DWG		SCALE FULL			SHEET 1 OF 1

FIGURE 14. SOLID STATE RELAY ASSEMBLY

1 THOUGHLY COAT BOTTOM OF RELAY WITH THERMAL COMPOUND TO CREATE A GOOD HEAT CONDUCTIVITY WITH HEAT SINK

IS: UNLESS OTHERWISE SPECIFIED

P.L. 1654248 REV B SHT 1 OF 1
DESCRIPTION RELAY ASSY, SOLID STATE
NEXT ASSY MULTIWAGE BY RA CK'D ____ APPD Chuc

REV	ECN	DATE	BY	APP
A	5281	2-23		
A	5471	2-16		
B	5180	2-28-84	DH	

DELTA DESIGN
5728 KEARNY VILLA RD.
SAN DIEGO, CALIF.

JOB NO. ____ S.O. NO. ____
QTY ____ PROM DATE ____ ACT ____
RUN ____ MACH ____

ITEM NO	ASSY & QTY -001	-002	-003	-004	INDENTURE	SIZE	DRAWING NO.	REV	DESCRIPTION	MFG OR MFG NO.	STOCK OR PART NO.	JOB QTY	ALL	QTY REC	FAB CD	PURCHASING P.O. NO	QTY.	DUE	REC	MANUFACTURE ACT STD HRS.	EST ACT COM.	COM.	PLATE/PAINT IN	OUT	AREA
01	X					B	1654248		RELAY ASSY, SOLID STATE		1654248-001														
02		X				B	1654248		RELAY ASSY, SOLID STATE		1654248-002														
03																									
04																									
05																									
06																									
07																									
08																									
09																									
10																									
11																									
12																									
13																									
14																									
15																									
16																									
17																									
18																									
19																									
20																									
21	1	1				B	1654184		HEATSINK, SOLID STATE RELAY		1654184-101														
22																									
23	1	2							RELAY, SOLID STATE	CRYDOM D2425	1400154														
24	2	4							SCREW 8-32 x .375 SHC-MS		6808323-808														
25	2	4							WASHER, SPLIT #8		6608010														
26	AR	AR							THERMAL COMPOUND		9900026														
27																									

NOTES:

1654248 P/L REV B

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